Evaluation of reaction cross section data used for thin layer activation technique

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Thin layer activation (TLA) is a widely used nuclear method to investigate and control the loss of material during wear, corrosion and erosion processes. The process requires knowledge of depth profiles of the investigated radioisotopes produced by charged particle bombardment. The depth distribution of the activity can be determined with direct, very time-consuming step by step measurement or by calculation from reliable cross section, stopping power and sample composition data. These data were checked experimentally at several points performing only a couple of measurements.

As part of the results and conclusions of the IAEA Co-ordinated Research Programme on "Thin layer activation method and its application in the industry" a database was reported in the final Technical Document, containing TLA profiles and relevant cross sections for 35 reactions induced by p, d, ^{3}He and alpha-particles on 12 different elements. Later a computer program package was developed using this database published in the CRP Technical Document.

In the last decade a systematic investigation on charged particle induced nuclear reactions on metals was in progress at the Debrecen Cyclotron Laboratory for different applications in collaboration with other cyclotron laboratories and with the IAEA, including systematic cross-section measurements, data compilations and evaluations.

Activity-depth distribution functions are also frequently deduced from the obtained evaluated cross sections and compared with the directly measured calibration curves or other calculated curves published in the literature. We found significant disagreements between the result of the published values and our results and other reported data. It is difficult to find the reason of the disagreements between the directly measured and the calculated values because of the lack of initial parameters for the directly measured values, which are usually not fully published. In case of calculated TLA curves (like data in TECDOC) the initial parameters are well defined (and reported) therefore the comparison was possible.

To clarify the disagreements between our calculated data with those deduced from the TLA database we decided to investigate the possible reasons for the disagreements. Concerning that the accuracy of stopping power calculations is significantly higher than the accuracy of the corresponding cross section data, we compared first the recently published recommended cross section data with those in the basic input data file of the TLA database.

The systematic comparison showed significant disagreements in many cases. The results will be presented and the possible reason of the disagreements will be discussed. The improvement and extension of the TLA database is proposed with extended list of the candidate reactions based on more recent evaluated data.

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